SATELLITE MICROWAVE PRODUCTS

Aertech
INDUSTRIES
a subsidiary of TRW

Satellite Communications Division

Catalog No. 0681

Cover Photo: DSCS II on Orbit

Aertech Industries
Satellite Communications Division

The Satellite Communications Division of Aertech Industries specializes in the custom design, engineering, and manufacture of advanced technology microwave integrated circuits, discrete components, and vertically integrated subsystems which meet the special high reliability requirements of the satellite market. Aertech's experience dates back to 1968 with the DSCS II satellite program. Since that time, the Satcom Division has expanded its scope to include programs such as the Applied Technology Satellite, NATO III, DSCS III, ANIK B, the Joint U.S. Canadian Technology Satellite, TDRSS, LANDSAT, Space Shuttle, and IUS. Our accomplishments, over the past 13 years, have been characterized by excellent product performance, and a rapidly growing mix of product designs.

In performing its critical function, the Division conforms strictly to the parts, material, construction, testing and documentation requirements set forth by the military, NASA and commercial satellite establishments. Manufacturing processes are rigidly controlled and documented, and all assemblers and technicians are trained in and certified to NASA requirements. The Division maintains its own MIC facility, including an environmentally controlled area for RF testing. Test facilities also include semi-automatic test stations which are programmed for both standard specification testing and testing to special requirements. A product assurance department qualified to inspect to space program requirements is an integral part of the Satcom Division.

These exacting standards are reflected in the product capability described on the following pages. As with all Satcom products, the devices shown here are built and tested for the optimum reliability and long life required by the satellite industry. We invite you to contact us to learn how Aertech can assist you with your space oriented programs.

Organization

Aertech is organized to handle engineering and manufacturing programs from the straightforward re-build of previously supplied hardware to programs requiring the incorporation of innovative design concepts and new technology. Each of Aertech's divisions provides an integrated management, design, manufacturing, and quality control capability. The Satellite Communications Division (Satcom) employs a matrix organization whereby a program manager is assigned responsibility for one major program or several smaller programs. Program managers have complete management control over all phases of their programs with the exception of product assurance.

The Product Assurance Manager reports directly to Aertech's President and directs the quality requirements of each program through a quality engineer who is assigned specifically to that program. He is also responsible for the inspection team and performs an audit and surveillance function over all work performed in the Satcom Division.

The Division supports two manufacturing areas; one for MIC products, and a second for subsystems and standard components. Each manufacturing group is supported by its own production control, manufacturing and process control engineering groups.

New product designs and development for the Satcom Division are derived from Satcom's own design group, from the other Aertech Divisions, or from technology transfer from the parent company, TRW, Inc.

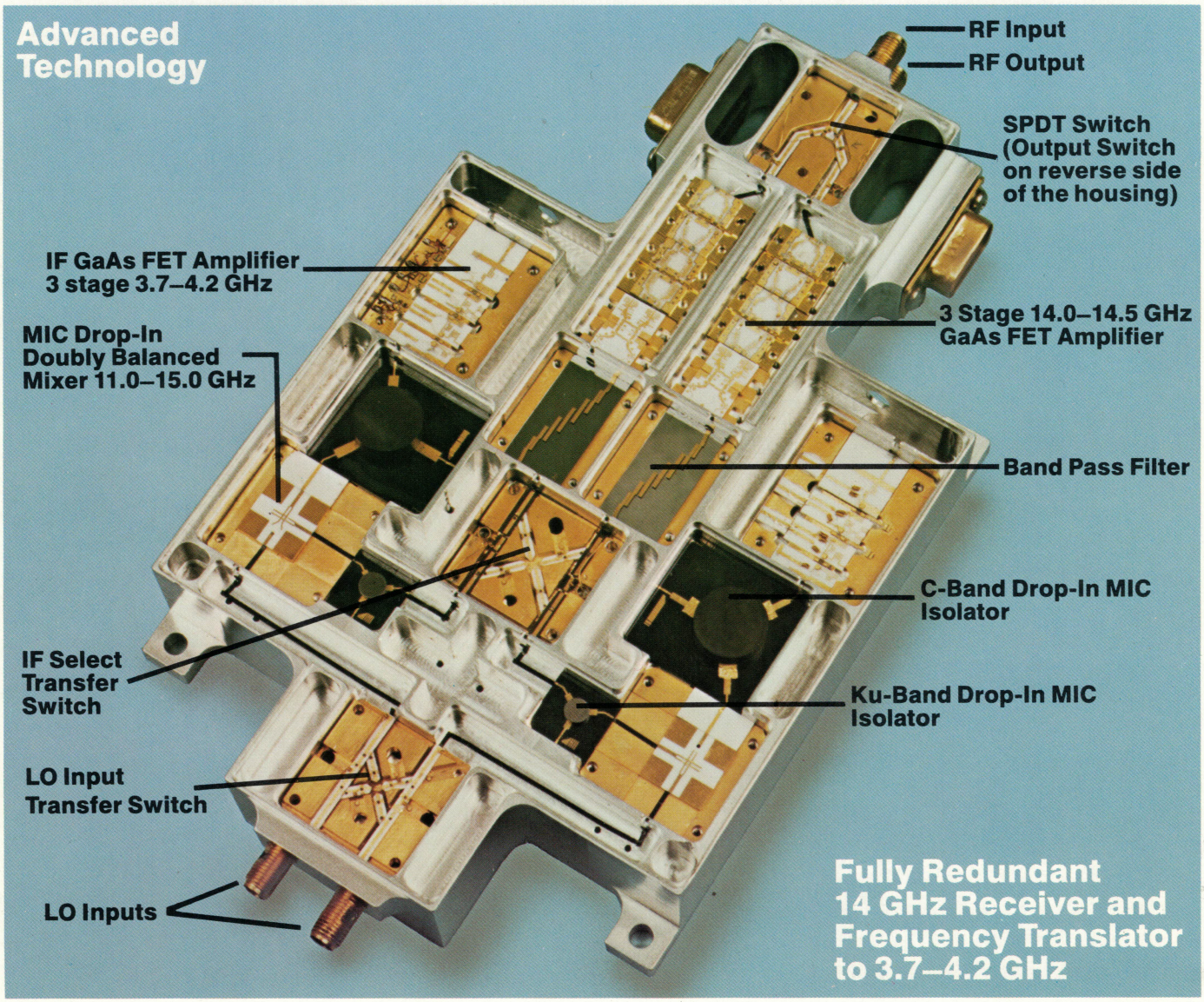
Introduction

The following pages present specific examples of Aertech products which have been qualified, or are now in the process of being qualified, for space applications. The majority of our recent product growth has been in designs for integrated frequency conversion subsystems (using both MIC and discrete technology), MIC switch and switch matrix products, and all MIC integrated, multi-function packages. In a brief listing such as this, many detailed parameters cannot be included, however, additional information is readily available from our Applications Engineering Department. Data relative to communications and telemetry applications can also be provided upon request.

Old designs (pre-1975) which have not been built recently are not shown. In addition, this section does not include many Aertech components which are assembled into our frequency converters, receivers and subsystems for space use, nor does it include the many types of Aertech diodes which have been qualified for use in our tunnel diode amplifiers, mixers, switches, attenuators, and detectors.

The Satcom Division continues to make a substantial investment in IR&D, particularly in the area of sophisticated, vertically integrated subsystems which utilize various Satcom components. An example of this technology is the redundant, Ku-band integrated MIC receiver and frequency translator which is shown below.

Advanced Technology

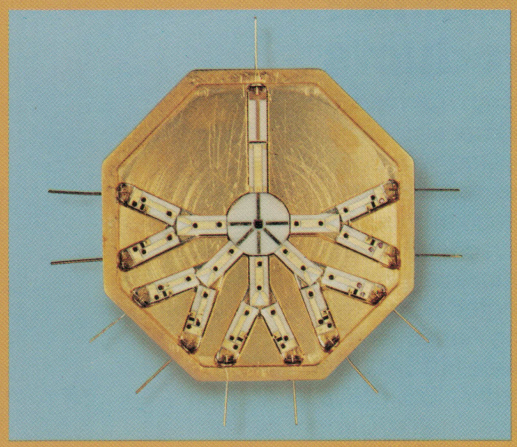

RF Input
RF Output
SPDT Switch (Output Switch on reverse side of the housing)
IF GaAs FET Amplifier 3 stage 3.7–4.2 GHz
3 Stage 14.0–14.5 GHz GaAs FET Amplifier
MIC Drop-In Doubly Balanced Mixer 11.0–15.0 GHz
Band Pass Filter
C-Band Drop-In MIC Isolator
IF Select Transfer Switch
Ku-Band Drop-In MIC Isolator
LO Input Transfer Switch
LO Inputs

Fully Redundant 14 GHz Receiver and Frequency Translator to 3.7–4.2 GHz

MIC Switch Modules & Switch Systems

Aertech switch modules have found extensive use in satellite programs. In addition to the switch modules described, Aertech is developing switch systems which combine switches, power dividers, cables, and TTL compatible logic for switch control. All designs are based on our MIC technology, using diode chips on alumina substrates which are sealed in hermetic packages. The modules are often mounted in housings with SMA connectors.

Aertech PIN diodes are incorporated into most of these designs.



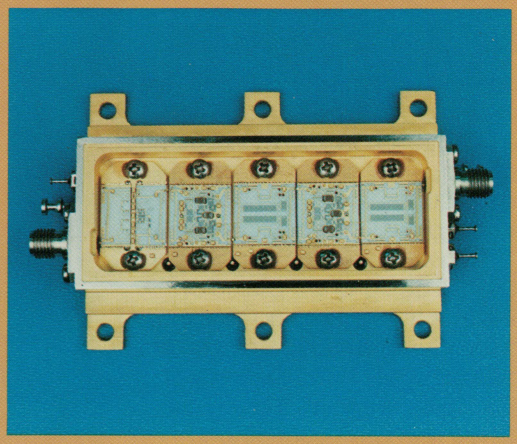
Single Pole, 10-Throw Terminated Switch Module Covers 200 to 2000 MHz.

Model Number	Frequency Range (MHz)	Insertion Loss Max (dB)	Isolation Min (dB)	Switch Speed Max Nanoseconds	Size (inches)	Comments
Transfer Switch Modules						
AMT7039	600–824	0.8	55	20	.35 x .135[1] dia	Usable frequency range is 500–4000 MHz
AMT7052	1750–1850	1.5	45	2000	.15 x .75[1] dia	
Single Pole Single Throw Terminated Switch						
AMT7037	100–2500	1.0	50	200	.75 x .45 x .15	Max VSWR 1.5:1 in either on or off state
Single Pole Four Throw Switch						
	2000–8000	2.0	50	200	.15 x 1.0 dia	
Single Pole Six Throw Switch						
	7800–8500	3.6	80	500	1.5 x 1.5 x 1.5	VSWR 1.5:1 includes drivers
Single Pole Eight Throw Switch						
AMT7036	100–2500	1.5	50	500	.15 x .75 dia	
Single Pole Ten Throw Switch						
	200–2000	2.5	90	200	.15 x 1.4 dia	Flat Pack driver available

[1]Does not include 4–40 UNC-2A mounting stud .15 long approx.

Transistor Amplifier Products

Aertech has manufactured over 1000 transistor amplifiers for use in satellites, with both bipolar and FET types represented. In addition, Aertech produces many amplifiers which contain integrated variable attenuators, protection limiters and detected output monitors. Programs using Aertech transistor amplifiers include FLTSATCOM, TDRSS, Landsat, IUS, DSCS III, and the Space Shuttle. Current designs include FET Limiting Amplifiers.



S-band Low Noise Amplifier with two built-in balanced PIN diode attenuators for gain control, and three solid state amplifier stages.

Microwave Amplifiers With SMA Connectors

Type	Frequency Range (GHz)	Gain dB (min)	Noise Figure dB (max)	Output @ 1 dB Comp. (dBm)	VSWR	Bias Volts @ Current (max)	Size Without Connectors (inches)
A2201–01	.1–.19	35	1.8	+8	1.5:1	13 V @ 75 mA	2.3 x 4.95 x .8
A2201–02	.15–.29	35	1.8	+8	1.5:1	13 V @ 75 mA	2.3 x 4.95 x .8
A2201–03	.26–.41	35	1.8	+8	1.5:1	13 V @ 75 mA	2.3 x 4.95 x .8
A23106	.4–.8	33	2.1	+5	1.5:1	13 V @ 60 mA	2.3 x 4.95 x .67
A4448	1.4–2.2	23	3.5	+5	2.0:1	13 V @ 63 mA	2.5 x 2.8 x .76
A5307	2.2–2.3	29	2.3	0	1.5:1	15 V @ 64 mA	4 x 2 x 2
A6606	7.25–7.75	26	6.5*	+7	1.5:1	12 V @ 165 mA	4.0 x 2.5 x .75
A7405	7.9–8.4	36	5.5*	+10	1.5:1	12 V @ 150 mA	4.8 x 1.9 x .65

Microwave Amplifiers With SMA Connectors and Pin Diode Gain Control

A5308	2.1–3.2	(A) 38 (B) 3	(A) 2.9 (B) 5.5	(A) +7 (B) –25	Input: 1.5:1 Output: 2:1	13 V @ 130 mA	2.25 x 3 x .8
A5425	2.1–3.2	(A) 38 (B) 3	(A) 4.3 (B) 5.5	(A) +7 (B) –25	Input: 1.5:1 Output: 2:1	13 V @ 100 mA	2.35 x 2.94 x .88

*Over the temperature range of –34 to +71°C
(A) and (B) indicate values at two gain modes.

Microwave Amplifier with +36 dBm Protection Limiter and SMA Connectors

A5401–02	2.0–2.3	28	3.1	+5	1.5:1	+12 V @ 70 mA	1.4 x 2.15 x .60

MIC Amplifier Modules

Model Number	Frequency Range (MHz)	Gain (dB)	Noise Figure (dB)	Output @ 1 dB Comp. (dBm)	VSWR In	VSWR Out	Bias Volts at Current Max	Package Size (inches)
AMT7040	1761–1842	18–22	3.5	–3	1.3:1	1.5:1	8 V @ 30 mA	1.13 x .66 x .12
AMT7035	2000–2300	26	2.0	+10	1.25:1	1.25:1	12 V @ 60 mA	1.13 x .66 x .12
AMT7044	2000–2300	25	6	+13	1.5:1	1.5:1	12 V @ 100 mA	1.13 x .66 x .12
AMT7048	2000–2300	28	3	0	1.5:1	1.5:1	12 V @ 60 mA	1.13 x .66 x .12
AMT7041	2022–2132	18–22	3.5	–3	1.3:1	1.5:1	8 V @ 30 mA	1.13 x .66 x .12
AMT7043	2175–2325	25 ± 1	5.0	+5	1.5:1	1.5:1	12 V @ 50 mA	1.13 x .66 x .12
AMT7059	3950–4150	10.5–13	3.5	+15	2.0:1	2.0:1	+8V @ 44 mA and –12 V @ 8 mA	1.02 x .77 x .16

MIC Amplifier Modules with Built in Balanced Pin Diode Attenuator

Model Number	Frequency Range (MHz)	Gain (dB)	Noise Figure (dB)	Attenuator Range (dB)	RF Output @ 1 dB Compression (dBm)	Bias Volts Vdc	Bias Amps mA	Package Size (inches)
1H407	200–275	29–31	4.0	40	0	12	45	14 PIN DIP
1H554	790–1600	17 ±0.5	5.0	20	+5	12	40	1.13 x .66 x .12
1H557	2000–2300	19 ±0.5	5.0	20	+5	12	26	1.13 x .66 x .12

MIC Amplifier Modules with Pin Diode Gain Control

Model Number	Frequency Range (MHz)	Gain	Noise Figure (dB)	RF Output @ 1 dB Compression (dBm)	Bias Volts Vdc	Bias Current mA	Package Size (inches)
AMT7056	72–94	Mode 1 12.2 ±0.4	N/A	N/A			1.75 x 1.30 x 0.2
		Mode 2 28.2 ±0.8	2.4	+14	+8	60	
		Mode 3 −3.8 ±0.4	N/A	+14	+5	15	
		Mode 4 12.2 ±0.6	2.4	+14			
AMT7057	76–94	Mode 1 −1.9 ±0.2	N/A	+17	+8	30	1.25 x 1.25 x 0.2
		Mode 2 14.1 ±0.4	2.4	+14	+5.2	10	
AMT7058	76–94	Mode 1 13.1 ±0.6	N/A	+15	+8	60	1.75 x 1.30 x 0.2
		Mode 2 29 ±1.0	2.4	+15	+5	15	

MIC Amplifier Modules with Built in Auxiliary Detected Output

Model Number	Frequency Range (MHz)	Gain (dB)	Noise Figure (dB)	Detected Output Voltage at −4 dBm Input (mV)	RF Output @ 1 dB Compression (dBm)	Bias Voltage Vdc	Bias Current mA
AMT7055	790–1600	25 ±1	5	50 mv into 10,000 ohms	+5	12	48
AMT7046	2000–2300	19 ±.5	5	50 mv into 10,000 ohms	+5	12	26

High Frequency Special Purpose MIC Amplifiers

Model Number	Frequency Range (GHz)	Gain (dB)	Noise Figure (dB)	RF Output @ 1 dB Compression (dBm)	Bias Voltage Vdc	Bias Current mA	Package Size (inches)
AMT7060	3.7–4.2	26	6	+25	12	45	2.5 x 2 x 1
AMT7061	11.7–12.2	45	4	+10	12	210	3.5 x 1 x .5
AMT7062	14.0–14.5	21	4	+7	12	90	2 x 1 x ⅜

Tunnel Diode Amplifier Products

As one of Aertech's earliest product lines, tunnel diode amplifiers, and the tunnel diodes themselves, have flown in space systems for over nine years. While Aertech tunnel diode amplifiers have operated from a low frequency of 2 GHz up to 20 GHz, most of our designs cover military and commercial communication frequencies.

Aertech supplied the majority of the microwave solid state amplifiers currently orbiting on DSCS II and NATO III and continues to provide the tunnel diode limiting amplifier on DSCS III. Aertech tunnel diode amplifiers fly on the Joint U.S.-Canadian Communications Technology Satellite, the Applications Technology Satellite and Anik A and B. An Aertech TDA will be used on the TDRSS satellite, as well.

Tunnel Diode Amplifiers

Product	Frequency Range (MHz)	Bandwidth Min (MHz)	Gain (dB)	Noise Figure Max (dB)	Output at 1 dB Comp. (dBm)	Comments
NATO III TDAP	7970–8170	200	16 ± 0.5	6.1	−14	Redundant units with latching circulator switches on input and output
NATO III TDAD	7240–7440	200	26.5 ± 0.5	10	−10	High saturated output greater than −3 dBm
DSCS II TDAP-1	7900–8100	200	12 ± 0.5	6.4	−12	The DSCS II TDAP models are redundant with ferrite latching switches on input and output mating with UG138/U waveguide flanges
DSCS II TDAP-2	8125–8400	275	12.5 ± 0.5	6.4	−12	
DSCS II TDSA-1	7250–7450	200	23 ± 1	6.0	−13.5 ± 1.5 (saturated output)	The TDSA operates in a saturated mode
DSCS II TDSA-2	7490–7750	260	23 ± 1	6.0	−13.5 ± 1.5 (saturated output)	
TDRSS Advanced Westar Preamplifier	5900–6400	500	14	5.4	−14	

Tunnel Diode Amplifier Limiters

Program	Frequency Range (MHz)	Number of Channels	Bandwidth of Widest Channel (MHz)	Small Signal Gain (dB)	Number of Gain Steps	Gain Step Size (dB)	Max Saturated Output (dBm)	Noise Figure Max (dB)
DSCS II	7900–8400	4	185	60	7	5	−8	9
NATO III	7970–8170	3	85	30	7	3	−8.5	8
DSCS III	7900–8400	6	85	58	5	Various	−9	10
DSCS III	7290–7298	1	8	NA*	—	—	−14.0	15

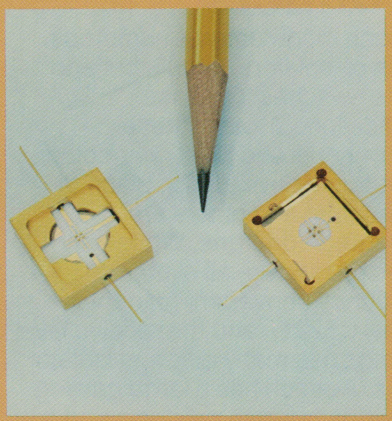
*Limiter Application only.

Mixer Products

Aertech mixers are found in numerous applications because of their wide bandwidth and high frequency capability. The majority of these mixers feature our Orthostar® design. Aertech mixers are doubly balanced and are produced in both four and eight diode configurations. Designs have been built for high reliability applications in octave bandwidths and frequencies up to 20 GHz. Flat pack modular designs on alumina and fused quartz substrates are available.

Mixer systems for special applications have also been designed. For example, Aertech is presently qualifying a dual mixer design which combines two, 8-diode Orthostar® mixers with couplers and power dividers.

Diodes used in these mixers are manufactured in Aertech's semiconductor facility, with both chip and packaged configurations being utilized.



ORTHOSTAR® Mixers on alumina substrates shown in flat pack housings.

Mixers with SMA Connectors

Type	Signal Input (GHz)	L.O. Input (GHz)	Signal Output (GHz)	L.O. Power (dBm)	Conversion Loss (dB)	Isolation (dB)	Size (inches) Less Connectors	Comments
MX5006	.2–2.5	4.4–6.6	4–4.1	+11	7	20	.875 x .875 x .67	
MX11504	1.7–1.9	7.9–8.5	6.2–6.6	+19	7.5	20	.66 x .625 x .625	*
MX4087	2–3.3	4.0	0.7–2.0	+11	7	20	1.3 x 1.3 x .67	
MX5007	3.0–4.7	5.0	.3–2.0	+11	7	20	1.1 x 1.1 x .67	
MX4086	4.0–4.1	4.0	.05–1	+11	6.5	20	1.04 x 1.04 x .67	
MX7025	4.5–6.7	7.0	.3–2.5	+11	7	20	.875 x .875 x .67	
MX8194	6.5–8.4	6.0	.5–2.5	+11	7	20	.88 x .88 x .67	
MX18072	11–15.2	13–13.4	.1–2.1	+9	7	20	.63 x .63 x .5	**
MX18539	16.0–20.0	15.0	1.0–5.0	+10	8	20	.62 x .62 x .375	

*8 diode design with +2.5 dBm min output at +10 dBm input
**Used as both up and down converter

Mixers Designed for Microstrip Integration in Teflon-Fiberglass Assemblies

Type	Signal Input (GHz)	L.O. Input (GHz)	Signal Output (GHz)	L.O. Power (dBm)	Conversion Loss (dB)	Isolation (dB)	Size (inches)
MX8195	.1–2.5	4.0–6.6	4.0–4.1	+11	7	20	.9 x .9 x .3
MX8196	4.0–4.1	4.0	.05–.1	+11	6.5	20	.9 x .9 x .3
MX8197	4–6.6	4.5–6.2	.1–.7	+11	7	20	.9 x .9 x .3

Mixers in Hermetically Sealed Drop-in Housings

Type	Signal Input (GHz)	Signal Output (GHz)	Conversion Loss[1] (dB)Max.	Isolation			Size[2] (inches)
				LO/RF (dB)Min.	LO/IF (dB)Min.	IF/RF (dB)Min.	
MX16512	.575–1.575	11.7–12.2 13.4–14.05	6.5	25.0	25.0	20.0	1.0 x 1.0 x .50
MX11520	1.941–2.166	8.10–8.325	5.5	25.0	30.0	20.0	1.0 x 1.0 x .50
MX16510	14.0–14.5	11.7–12.2	7.0	15.0	20.0	20.0	.65 x .65 x .20
MX16511	14.0–14.5	3.7–4.2	6.5	25.0	25.0	10.0	.65 x .65 x .20
MX18540	17.0–18.0	11.7–12.2	7.5	15.0	20.0	20.0	.65 x .65 x .20

Notes: 1. Nominal L.O. Power = +10 dBm
2. Mixers are available on carriers (Maximum Carrier Size—.75 x .75 inches)

Ferrite Products

Aertech manufactures numerous types of isolators, circulators and ferrite switches for space applications. Most of these components use SMA connectors, while some have tabs in place of connectors and others are waveguide designs. While only 13 types are shown, all of our frequency converters (except the Model C5221), and the receive level monitor, use many different isolator types. Aertech has a large catalog of standard ferrite products and any of these standard units can be built in the Satellite Communications Division, for space applications. Aertech has built circulators at frequencies up to 40 GHz.

The newest family in this product line is a series of Drop-in Isolators and Circulators, specifications for which are shown below.

Pin Diode Attenuator Modules

The two designs listed are used in TDRSS, however, many Aertech amplifiers use similar designs for gain control or in temperature compensation networks. All are balanced so that low VSWR is obtained for all attenuation settings, and designs are available at frequencies through 14 GHz.

Isolators—Coaxial

Model Number	Frequency Range (MHz)	Insertion Loss Max (dB)	Isolation Min (dB)	VSWR	Size Less Connectors (Inches)	Comments
AMF6060	650–750	0.5	20	1.25:1	1.5 x 1.5 x .75	.060 wide tabs for stripline or microstrip mounting
AMF6061	1700–1900	0.5	20	1.25:1	1.0 x 1.0 x .50	
AMF5486	7100–8600	0.4	25	1.12:1	0.7 x 0.75 x 0.5	SMA (f) connectors
A5719	3850–3950	0.7	27	1.22:1	1.0 x 1.0 x .5	Tab input, SMA output

Aertech manufactures isolators through 18 GHz for internal use. Coaxial designs from our Microwave Ferrite Products catalog can all be manufactured for space applications in our Satcom Division.

Isolators—Waveguide

AMF5784	7250–7450	0.15	20	1.1:1	Contact Factory	Rated RF Power 40 watts forward 6 watts reverse
AMF5785	7490–7750	0.15	20	1.1:1	Contact Factory	
AMF5991	11,910–13,410	0.4	20	1.25:1	1.87 x 1.34 x .875	Mates with UG 419/U flange
A5720	12,150–12,650	0.5	25	1.3:1	Contact Factory	WG input, SMA output

Isolators—Drop-In

Model Number	Frequency Range (GHz)	Insertion Loss Max (dB)	Isolation Min (dB)	VSWR
ATX1031	2.1–2.5	0.4	20	1.25:1
ATX1030	3.2–4.2	0.4	20	1.25:1
ATX1032	8.2–12.4	0.5	18	1.3:1
ATX1029	11.7–12.2	0.4	20	1.25:1
ATX1028	14.0–14.5	0.4	20	1.25:1

NOTES: 1. Various circuit metallizations or combinations are available.
2. Units are available with and without carriers
3. Unit substrate size is 1" x 1" for frequencies below 4 GHz, and .5" x .5" for frequencies above 4 GHz.

Balanced Pin Diode Attenuator Modules

Model Number	Frequency Range (MHz)	Insertion Loss (dB)	Attenuator Range (dB)	VSWR	Max Input Power (dBm)	Control Current Range, mA	Size (inches)
AMT7049	790–1600	2	25	1.5:1	+20	0–8	.66 x .63 x .15
AMT7050	2000–2300	2	25	1.5:1	+20	0–8	.66 x .63 x .15

Can be supplied with octave bandwidths up to 18 GHz

Detector Products

Aertech routinely supplies commercial detectors in wide frequency ranges up to 40 GHz, and many types have been supplied in the past for space use. Any of the detectors described in Aertech's detector brochure can be manufactured by the Satcom Division, and both tunnel and Schottky diode detectors can be provided.

Comb Generator Modules

In addition to the two comb generator modules shown below, many other types can be supplied for space programs.

Detector Products

Model Number	Frequency Range (MHz)	Video Bandwidth Min (KHz)	Flatness Max (dB)	Output Polarity	Output Voltage (μV)
DX1364	10–1500	10	±0.2	Negative	300 ±50 with −15 dBm input
DX1382	7250–7540	Not specified	±0.2	Positive	4500 ±500 with −24 dBm input

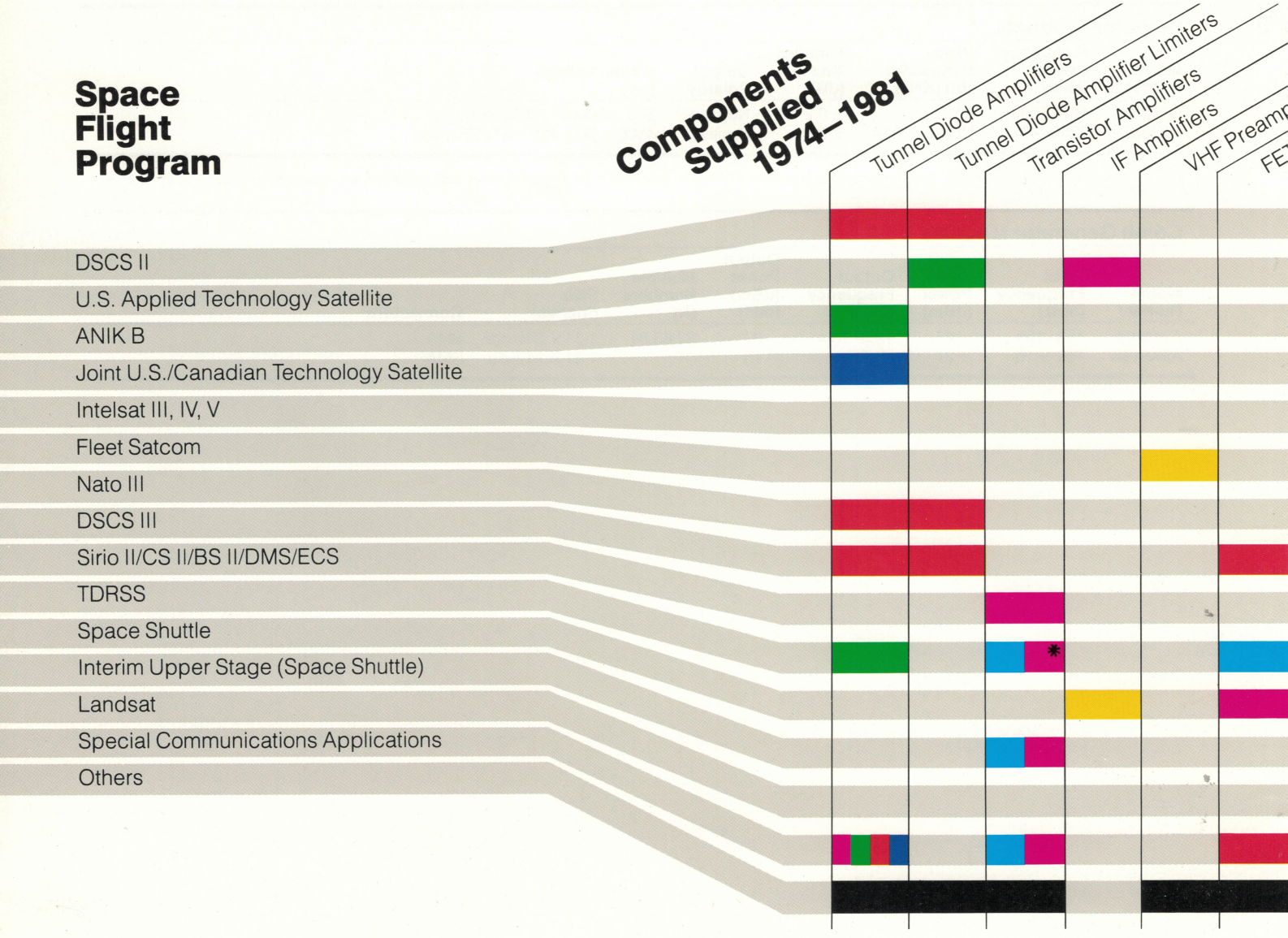
This chart represents products currently being manufactured in quantity. All products described in the Aertech Detector Catalog can be manufactured by the Satellite Communications Division for space programs.

Comb Generator Modules

Model Number	Input Frequency (MHz)	Input Power (dBm)	Output Frequency (GHz)	Output Power (dBm) (min)	Multiple Numbers (N)	Size (inches)	Connectors
A9X645B	153–159	+27	12.5–13.4	−27	82,83,84	1.31 x .312 dia	SMA
A9X549B	100 ±10	+27	.4–8.5	−15	—	1.31 x .312 dia	SMA

Participation In Approximately 70 Space Vehicles

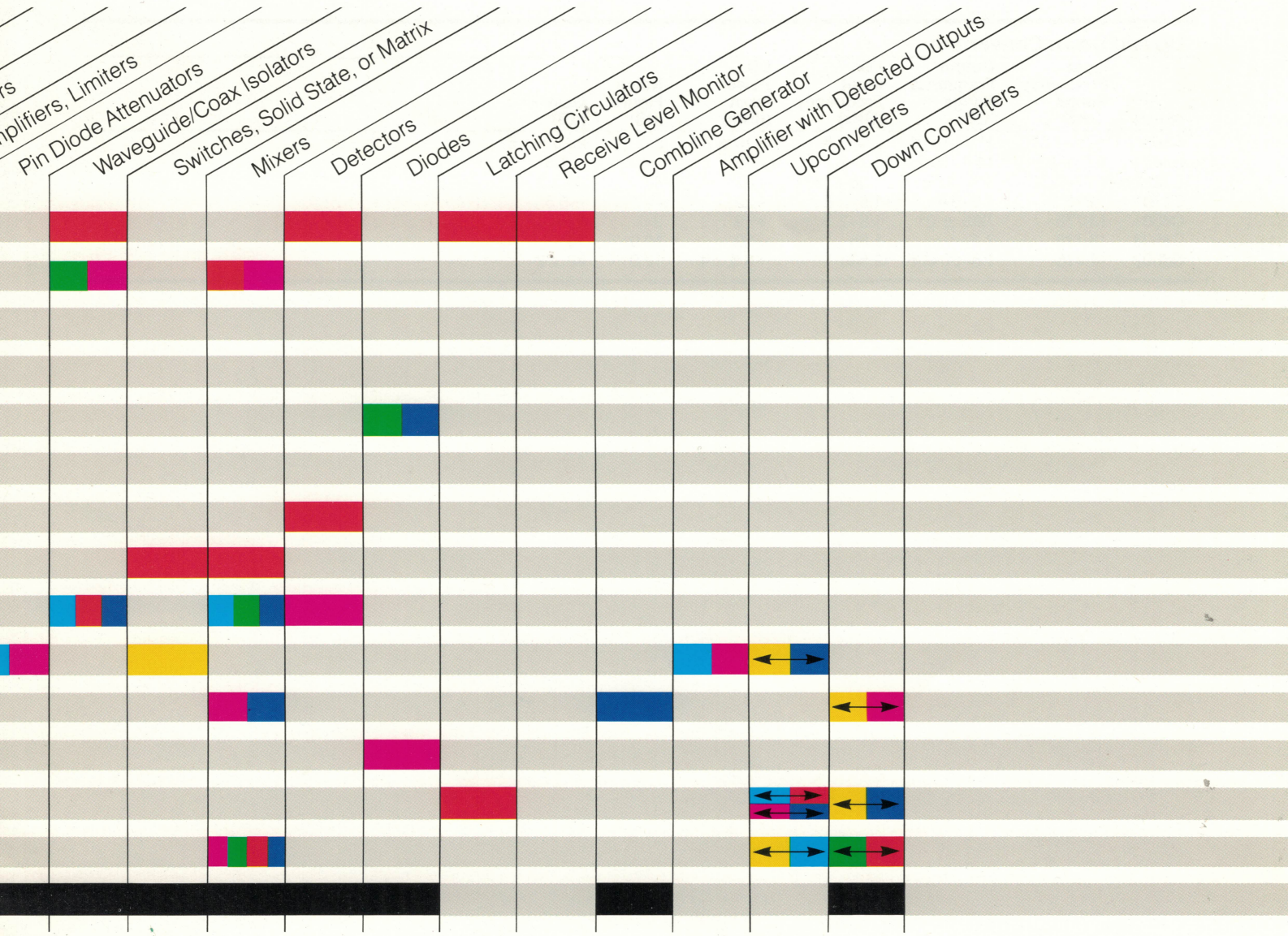
Space Flight Program



Frequency Band Color Code

- VHF-UHF 50–1000 MHz
- L 1–2 GHz
- S 2–4 GHz
- C 4–7 GHz
- X 7–11 GHz
- Ku 11–18 GHz
- OTHERS

* 9 Types



Up and Down Converters

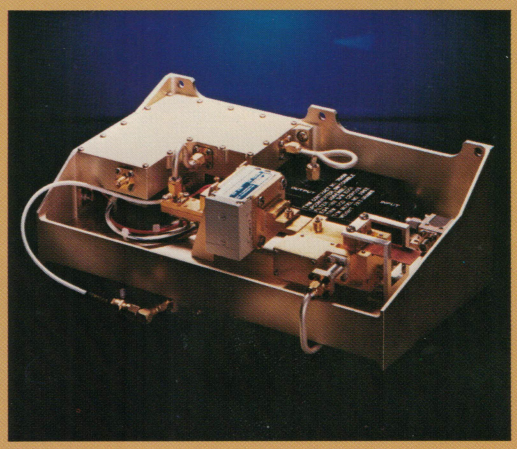
The seven types listed below are all in current production. Over 60 of the Model C3801 upconverter have been built for the TDRSS program while the C5221 has flown in the Space Shuttle, and the balance of the designs are used in Landsat-D. Other models are in production and will be qualified shortly. The block diagrams show the wide variety of Aertech manufactured components which can be integrated into an assembly.

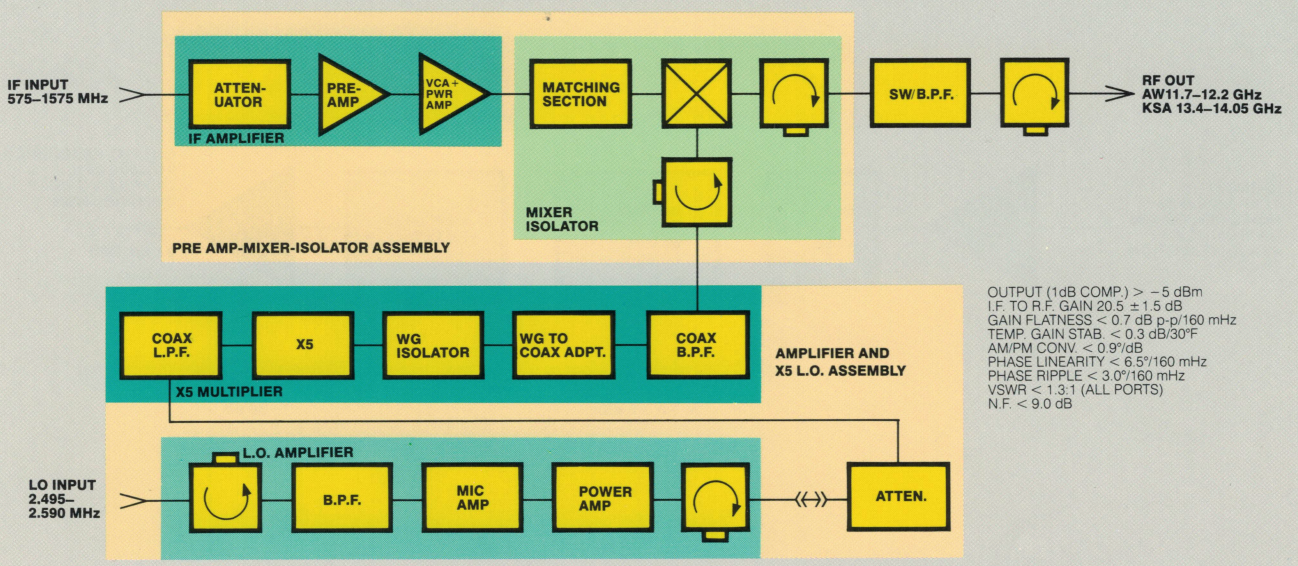
Up and Down Converters

Model	Input Frequency Range (GHz)	Output Frequency Range (GHz)	LO Input Frequency (GHz)	LO Power Input (dBm)	Noise Figure (dB)	Gain (dB)
C3801	.575–1.575	11.7–14.05	2.5–2.6	−10 ±2.5	9.0	20.5 ±1.5
C4801	1.7–2.1	14.8–15.2	1.7–2.2	+15	—	−1.5
C5221	1.77–2.12	.21–.275	1.56–1.88	+8	4.0	25 ±3
C4701	1.8–2.2	7.9–8.4	1.8–2.2	+22	—	−8.5
C8501	13.775	.075 ±.01	1.8–2.2	+19	9.0	37
C8503	13.775	2.1	1.95	+20	10.0	18
C8502	14.775	1.8 ±0.035	2.595	−8.5 ±4	12.0	22 ±2

TDRSS Ku-Band Upconverter

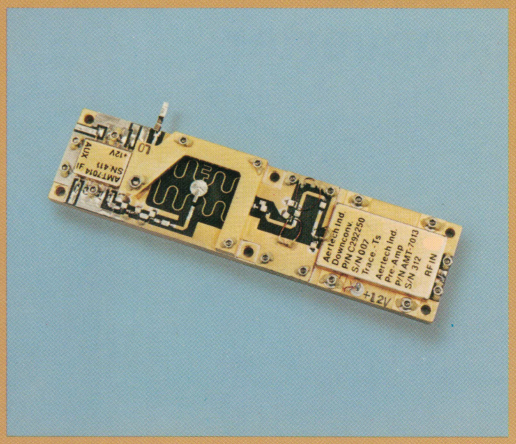
Upconverter. The model C3801 is an upconverter designed for the TDRSS satellite. The 575 to 1575 MHz input is amplified and then upconverted in an Aertech Orthostar® doubly balanced mixer. The output is between 11.7 and 14.05 GHz. A x5 multiplier is used to obtain the L.O. signal from a 2.495 to 2.59 GHz input.



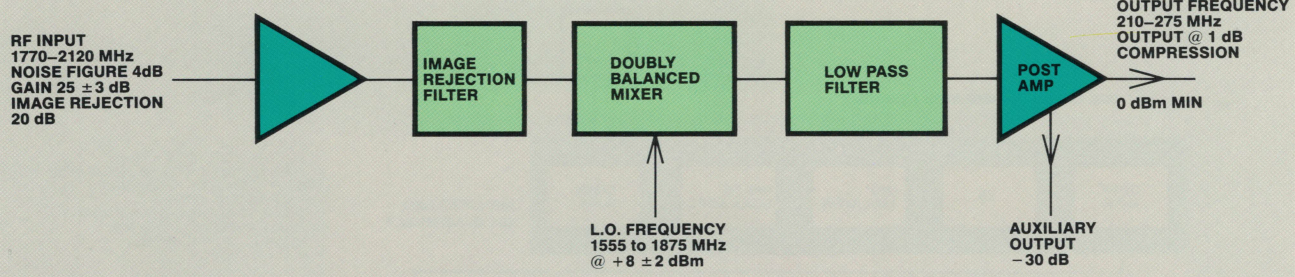


OUTPUT (1dB COMP.) > −5 dBm
I.F. TO R.F. GAIN 20.5 ±1.5 dB
GAIN FLATNESS < 0.7 dB p-p/160 mHz
TEMP. GAIN STAB. < 0.3 dB/30°F
AM/PM CONV. < 0.9°/dB
PHASE LINEARITY < 6.5°/160 mHz
PHASE RIPPLE < 3.0°/160 mHz
VSWR < 1.3:1 (ALL PORTS)
N.F. < 9.0 dB

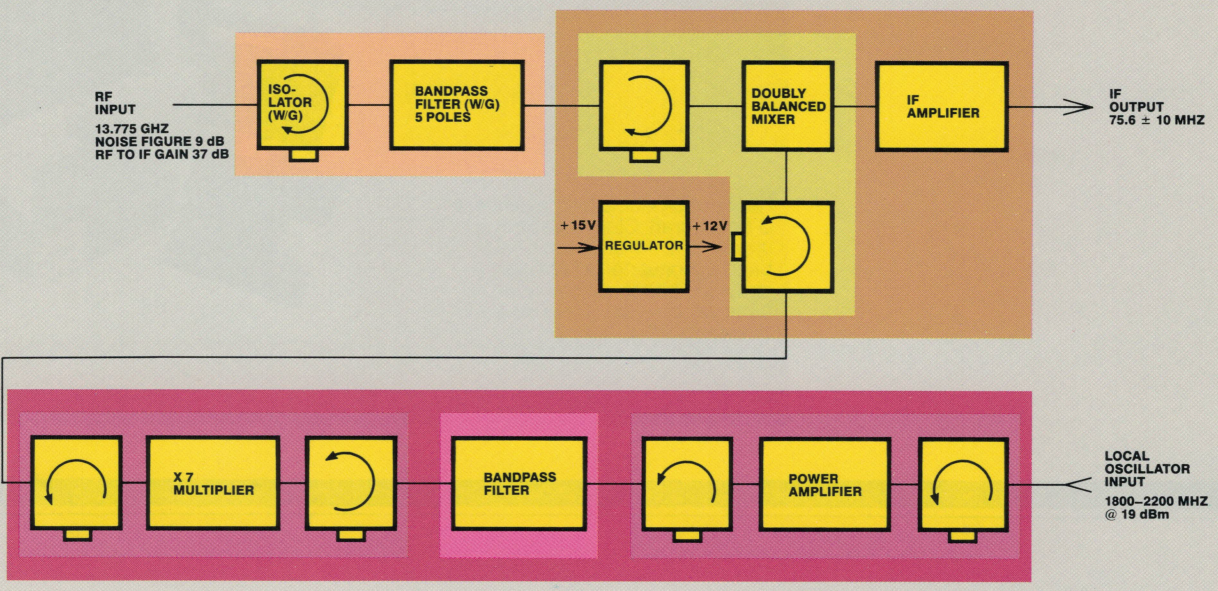
Space Shuttle S-Band Down Converter



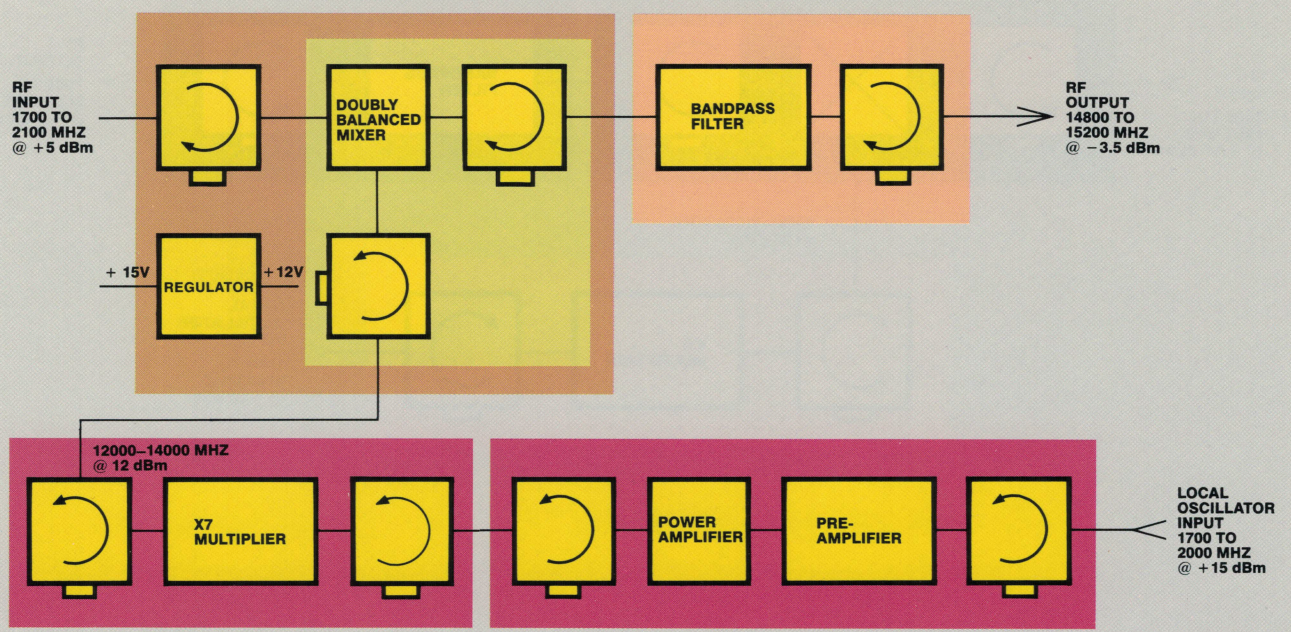
Preamplifier Down Converter for Space Shuttle. This small assembly includes a 20 dB, S-band MIC preamplifier, filter, Orthostar® doubly balanced mixer and an MIC VHF output amplifier. It measures approximately 4″ x 1″ x ½″.



Satellite Communications Division
C5221 S-Band Down Converter

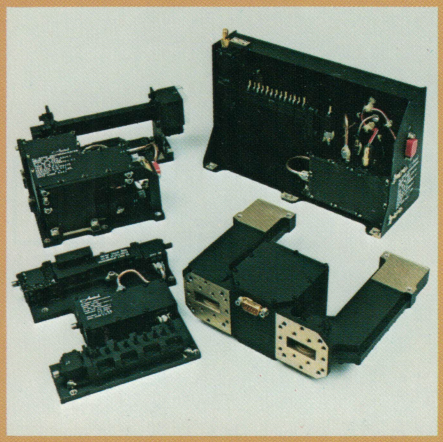


Satellite Communications Division
C-8501 Landsat Ku-Band Down Converter

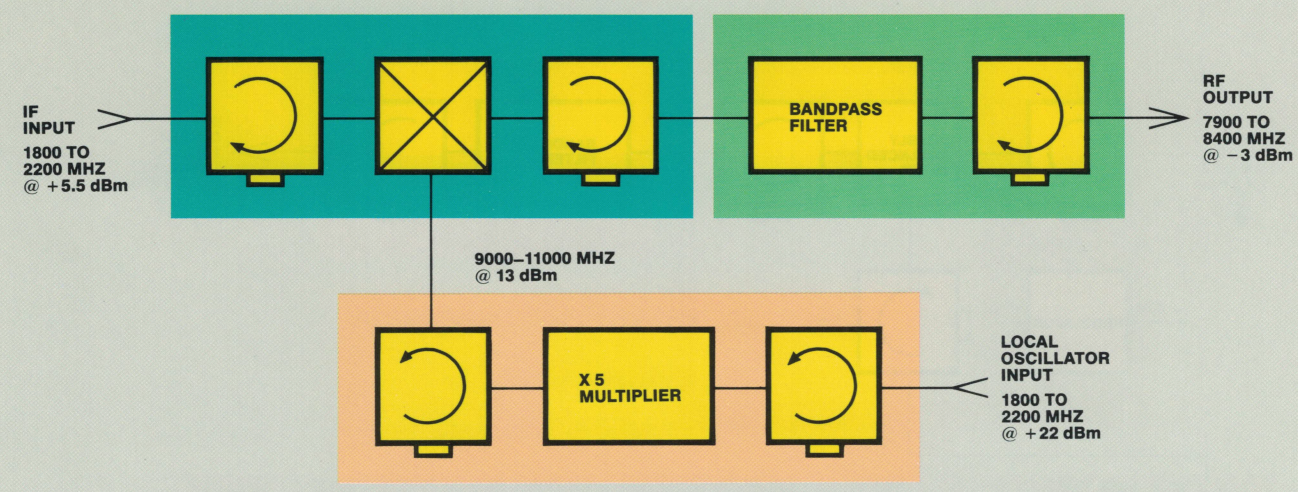


Satellite Communications Division
C-4801 Landsat Ku-Band Upconverter

X-Band Upconverter for Landsat



Family of products for the Landsat D Spacecraft. Clockwise from upper right, the units are a Ku-band upconverter, a latching circulator switch assembly, an X-band upconverter, and a Ku-band down converter.



Satellite Communications Division
C-4701 Landsat X-Band Upconverter

Product Assurance and Reliability

Aertech's Satellite Communications Division is served by a staff of quality and reliability engineers and inspectors who are thoroughly experienced with the quality and reliability aspects of NASA, DOD, Comsat and ESA procedures and specifications. Project oriented flow charts and shop orders specify mandatory inspection points, while detailed work instructions and procedures ensure that customer requirements are achieved.

TDRSS Satellite on Orbit

The Satcom Division's Quality Assurance Systems provide:

- Quality program requirements per MIL-Q-9858A.
- Vendor and Parts qualification with electrical and visual sampling per MIL-STD-883B. Test methods per MIL-STD-750; MIL-STD-202.
- Bonded stores inventory control.
- Destruct physical analysis, radiographic screening and scanning electron microscopy.
- 100% non-destructive bond pull testing.
- Reliability programs, prediction and analysis per MIL-STD-1543 & MIL-HDBK-217.
- Certification and validation of all processes and procedures.
- Daily certification of critical equipment.
- Certification of all operators. NASA certified instruction and certification capability per NHB 5300.4 (3A-1).
- Review of all project documentation.
- Control of non-conformance to the guidelines of MIL-STD-1520B.
- Full configuration control.
- Workmanship standards approved by eight major satellite payload manufacturers.

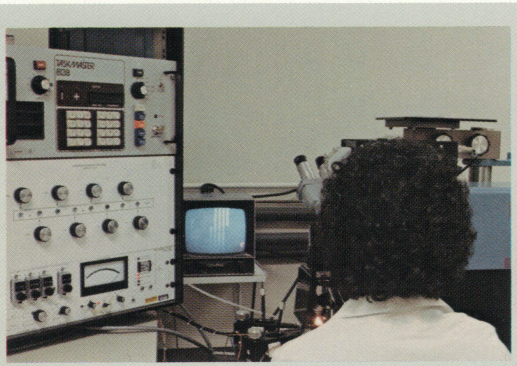
MIC Products

The MIC production facility is the result of a six year planning, building and training effort. Aertech Hi-rel MIC products manufactured here include amplifiers, switches, attenuators, limiters and mixers for applications such as TDRSS, Space Shuttle, DSCS III, and IUS.

All processes from substrate processing through RF test and final seal are performed in a clean room environment. Several RF test stations are included in the facility which permit tune and test of MIC components from high frequency (HF) through Ku-band (18 GHz).

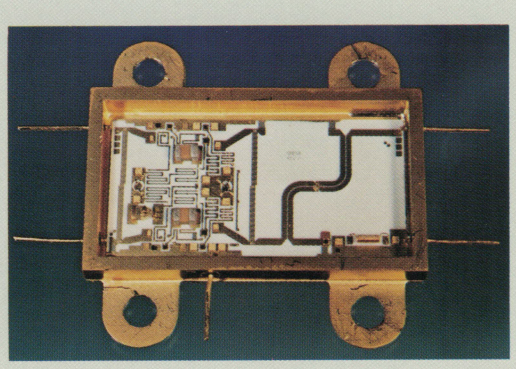
The MIC facility supplies thin film components on alumina or quartz substrates using a tantalum nitride-titanium/tungsten gold system. The bonding system used for RF circuits is monometallic, i.e. only gold bond wires to gold pads. An aluminum bonding system is used in non-RF circuits whenever IC's with gold bonding pads are not available.

Within the MIC facility, complete process documentation is in effect to allow processing to MIL-STD-883.



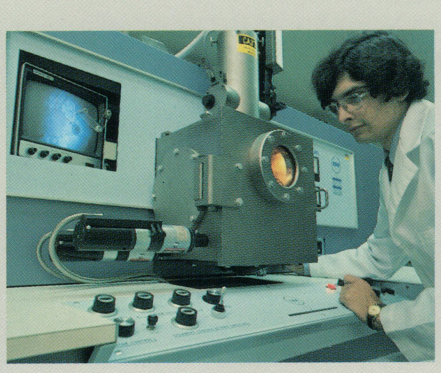
LASER TRIMMER. Thin film resistors are trimmed to within 1% accuracy using a laser trimmer controlled by a precision resistance bridge.

Parallel Seam Welder. Complimenting the electron beam welder is this parallel seam welder. Prior to sealing, units are baked in a vacuum oven which is an integral part of the sealer, then sealed in an inert gas atmosphere.

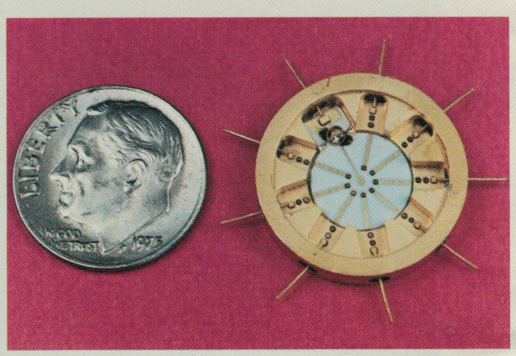


Amplifier with Auxiliary Detected Output. This typical two-stage balanced S-band amplifier includes a directional coupler and integral MIC compound detector which provides a high level detected output in addition to the RF output. The unit is qualified for use in the TDRSS satellite.

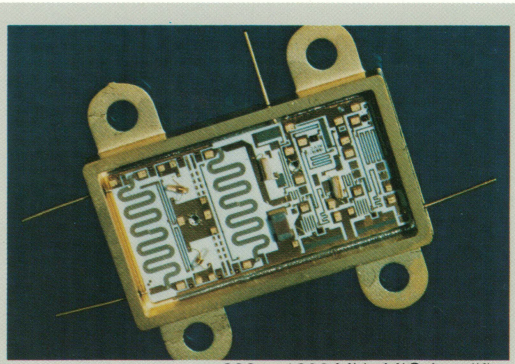
Single-pole, Eight-throw Solid State Switch module covering 100 to 2500 MHz.



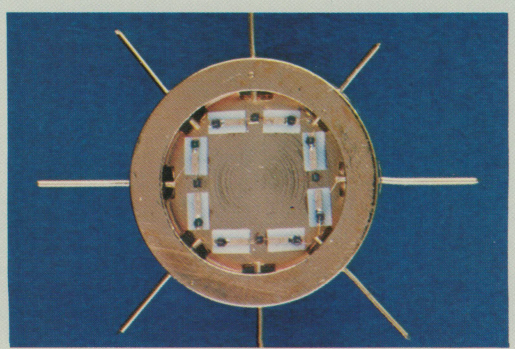
Electron Beam Welder. Making truly hermetic metal-to-metal seals in large quantity is essential to the production of microwave integrated circuits for spaceborne applications. Aertech's electron beam welder produces such seals on lightweight aluminum or Kovar amplifier housings in a high vacuum. The finished product can be leak checked and screened to MIL-STD-883B requirements.



Automated Testing. Calculator controlled test stations are available to provide fast, accurate test data on Aertech Satcom products. Data can be presented in either X-Y plotter or tabulated form. Magnetic tape storage of data is also provided.

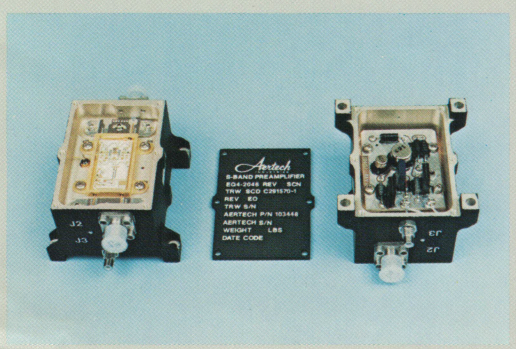


600 to 1600 MHz MIC Amplifier used on the TDRSS Satellite.



High Speed Transfer Switch Module. This small transfer switch can be switched in 5 nanoseconds when used with the proper driver. Arrays of these units are used where high data rate bursts are routed through a switch network.

Low noise S-band Amplifier used in the TDRSS Satellite. This FET amplifier has 1.9 dB, maximum noise figure. It can be supplied as an MIC module, or as shown integrated in a housing with SMA connectors and voltage regulator.



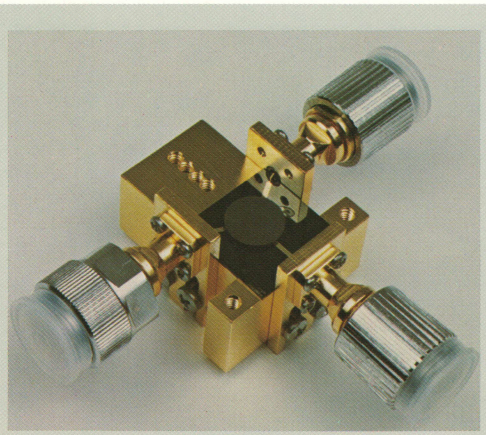
MIC Facilities. Aertech's fully equipped MIC facility is completely dedicated to space hardware manufacturing. Products are manufactured to both NASA and DOD requirements. Operators and equipment are certified.

Component and Subsystems Manufacturing

The Component and Subsystem Manufacturing Group supplies a wide range of microwave products for use in satellite applications. Any Aertech catalog item can be supplied for satellite use by this group, from small components like isolators, mixers, and detectors, to larger subsystems such as the receive level monitor for DSCS II, the tunnel diode amplifier limiters for DSCS II, NATO III, and DSCS III, and the Ku-band upconverter for TDRSS. The group also produces transistor amplifiers utilizing packaged semiconductors with softboard techniques.

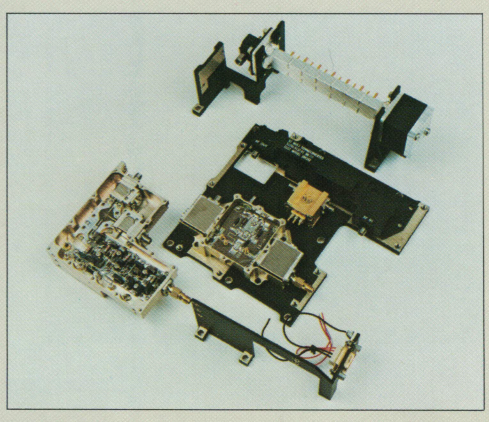
Aertech began production of components and subsystems for use in satellites in 1968. The first products were tunnel diode amplifiers used as preamplifiers, limiters and summing amplifiers. Both narrow band and octave bandwidth units have seen orbital service at frequencies up to 18 GHz.

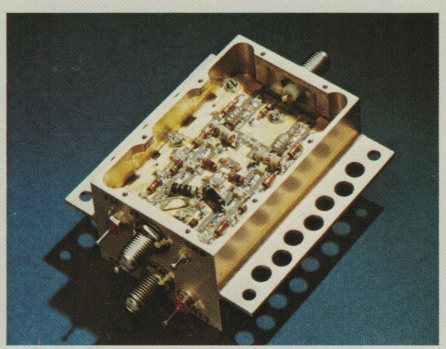
Within this facility, special controls are maintained to assure compliance with NASA, DOD, and commercial satellite manufacturers' requirements for quality, reliability, assembly, test, inspection, and documentation.



C-Band Drop-in Isolator in test-fixture. One of a family of new Ferrite product designs.

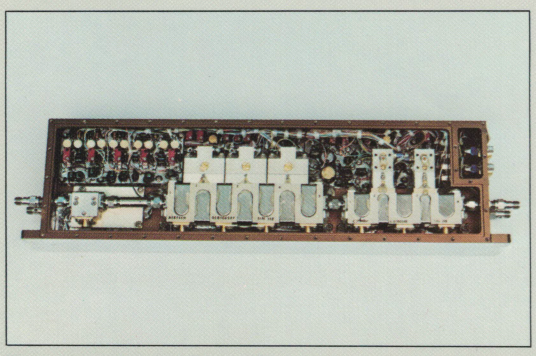
The Ku-band Down Converter for the Landsat D Satellite. As shown here, the converter is broken down into its major sub-assemblies. At the top is the coupled cavity bandpass filter; the center assembly is the L.O. input amplifier, isolators, and x7 multiplier; the assembly on the left shows an Aertech Orthostar® mixer, the IF amplifier, and two integrated isolators.





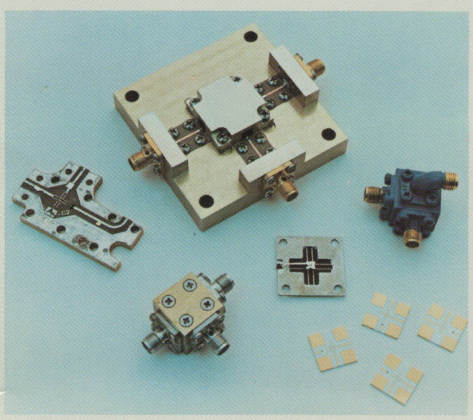
TRANSISTOR AMPLIFIER. This two-stage dual transistor amplifier is used as a VHF preamplifier on the FLTSATCOM Satellite. It has a frequency range from 290 to 400 MHz with a 2 dB noise figure.

Automatic Test Equipment. Aertech is often required to provide extensive data on each unit manufactured. Test stations such as the one shown can be programmed to supply accurate, repeatable data quickly and in a readily usable form.

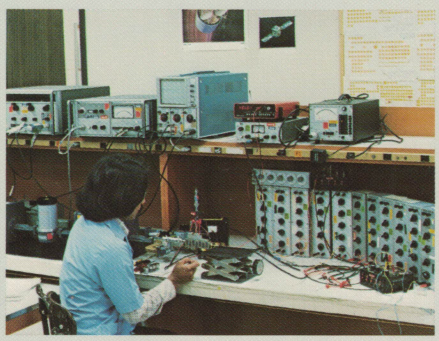


Five-stage, X-band Tunnel Diode Amplifier Limiter used in the DSCS III Communications Satellite. This unit provides constant output over wide input power ranges and 5 controllable gain levels.

Aertech supplies a wide variety of Orthostar® Doubly Balanced Mixers from L-through Ku-band. MIC drop-in designs or units with connectors are available as space qualified products.



Product Testing. Tuning and test of Aertech products is accomplished at program dedicated test stations. All equipment is carefully calibrated and semi-automated test equipment is utilized to assure repeatable, easily interpreted test data.



Skilled Personnel. Aertech assemblers and technicians are trained and certified to meet all requirements set forth for satellite hardware manufacturers. An experienced staff is totally dedicated to building satellite hardware. Thorough and clear procedures cover all phases of assembly and test.

Assembly Area. Aertech's small parts and subsystems assembly area is designed to meet the stringent requirements of NASA, SAMSO, and other satellite systems' quality assurance programs. Assemblers are certified and retrained at regular prescribed intervals. Assembly and inspection requirements are thorough and rigidly adhered to.

Aertech INDUSTRIES
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825 Stewart Drive, Sunnyvale, CA 94086 • Phone (408) 732-0880 • TWX 910-339-9207

Aertech Industries designs and produces a broad line of microwave products to serve the electronic warfare, radar, satellite, missile, telemetry, test equipment, and telecommunications markets. Currently included in our product line are the following:

Attenuators
Amplifiers
Bipolar
FET
CW Detector-Amplifiers
Detectors/Limiter Detectors
Digital Radio RF Units
Digital & Analog IFM Receivers
Down Converters
Ferrites
Isolators
Circulators
Frequency Sources
Limiters
LOG Video Amplifiers
MIC Subsystems
Microwave Diodes
Schottky
PIN
Silicon Step Recovery
Limiter
RF Control
Attenuator
Tunnel
Microwave Radio RF Units
Mixers/Mixer Preamplifiers
Polar Discriminators
Power Dividers
Switches
Up Converters
Video Amplifiers

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